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EXAMINER

LEWIS, BEN

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/627,238	Applicant(s) HOENTHANNER ET AL.	
	Examiner Ben Lewis	Art Unit 1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 19 June 2009.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,4-6,8 and 11-23 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,2,4-6,8 and 11-23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 24 June 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

Detailed Action

1. The Applicant's amendment filed on June 19th, 2009 was received. Claim 1 was amended. Claims 11-19 were withdrawn from further consideration. Claims 3, 7 and 9-10 were cancelled. Claims 22-23 were added.
2. The text of those sections of Title 35, U.S.C. code not included in this action can be found in the prior Office Action (issued on December 19th, 2008).

Claim Rejections - 35 USC § 103

3. Claims 1-2, 4-6, 8 and 20-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zuber et al. (U.S. Patent No. 6,156,449) in view of Yano (U.S. Patent No. 5,380,806) and Tsai et al. (U.S. 6,514,296 B1) and Yoshino et al. (U.S. Pub No. 2002/0048654 A1).

With respect to claims 1, 5 and 20-21, Zuber et al disclose a catalyst layer for polymer electrolyte fuel cells (title) wherein the homogenized ink may be applied on to the substrate material by means of various techniques. These include, for example, spraying, brushing, spreading or printing. After coating the substrate material with the ink, or dispersion, the coating obtained is dried at an elevated temperature. Ionomer, precious metal complex compounds and the drying temperature must be appropriately selected to achieve optimum results after drying (Col 6 lines 35-55).

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Zuber et al also teach that based on protocol II of U.S. Pat. No. 5,234,777 an MEA was produced as follows: a dispersion of 1 g support catalyst (Degussa, 20% Pt on Vulcan XC72), 10 g of a 5% NAFION.RTM. Solution in low-boiling alcohols (Aldrich, Karlsruhe), 3.3 g glycerol, 8.2 g water and 0.47 g 1 N NaOH solution was prepared. The mixture was dispersed in an ultrasound bath. A NAFION.RTM. 115 membrane in the Na.sup.+ form was attached to a heated plate. The mixture was applied onto one side of the membrane and dried at 150.degree. C. This procedure was repeated until the desired platinum load of 0.25 mg Pt/cm.sup.2 was reached. The reverse side of the membrane was then coated in the same way. Before being used in the PEM fuel cell, the membrane coated with catalyst was re protonated in 0.5 M sulfuric acid solution. The total platinum load (sum of the two catalyst layers) of the membrane electrode assembly was 0.5 mg/cm.sup.2 (Col 8 lines 1-15). (Examiner notes that since the ink composition of Zuber et al contains water as a constituent then the ink composition of Zuber et al is water based).

With respect to the amount of catalyst in the ink solution the disclosure Zuber et al as differs from Applicant's claims in that Zuber et al do not specifically teach 5%-75%wt. of electrocatalyst claimed by Applicant. However, Zuber et al. recognize the need for adjusting the amount of catalyst in the ink. Zuber et al. teach that the weight ratio of the conductive carbon particles to the ionomer in the ink is typically between 5:1 and 1:1, preferably between 4:1 and 2:1. The desired precious metal load (area concentration in mg/cm.sup.2) of the finished catalyst layer can be adjusted by means of a corresponding weight ratio of the precious metals to the carbon particles in the ink,

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with a given layer thickness. Weight ratios of the precious metals to the carbon particles of between 1:10 and 4:1 are preferably used (Col 6 lines 25-35).

Therefore, it would have been within the skill of the ordinary artisan to adjust the amount of electrocatalyst in the ink of Zuber et al to be within the Applicants claimed electrocatalyst range in order achieve the desired catalyst load. *Discovery of optimum value of result effective variable in known process is ordinarily within skill of art. In re Boesch*, CCPA 1980, 617 F.2d 272, 205 USPQ215.

Zuber et al. does not specifically teach leveling the deposited catalyst ink. However, Yano disclose an ink composition (title) wherein when the amount of the leveling agent is less than about 0.1 part by weight, a rough surface of the coating film attributed to the remainder of the foam generated at the time of the printing and the screen mesh is not sufficiently leveled, and pinholes are likely to be formed on the surface after drying and curing, so that the film tends to have a nonuniform thickness (Col 6 lines 25-45). Therefore it would have been obvious to incorporate the leveling procedure of Yano into the process of Zuber et al. because Yano teach that if the mesh is not sufficiently leveled, pinholes are likely to be formed on the surface after drying and curing, so that the film tends to have a nonuniform thickness (Col 6 lines 25-45).

Zuber et al as modified by Yano does not specifically teach controlling the temperature and humidity. However, Tsai et al. disclose a method of making an energy storage device (title) wherein the coating solution is applied to the support by a spray method, cured, and optionally repeated to increase the thickness. A preferred procedure is to apply the coating solution to the substrate at a temperature of 0-150 °C

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by means of an ultrasonic or other spray nozzle with a flow rate of around 0.1-5 ml/min in a carrier gas composed of nitrogen, oxygen and/or other reactive and inert gases.

The coating characteristics are controlled by the partial pressure of oxygen and other reactive gasses (Col 13 lines 40-50). Usually, constant temperature and humidity are important to obtain an even coat (Col 19 lines 40-50). Therefore it would have been obvious to one of ordinary skill in the art to incorporate the controlling of the temperature and humidity of Tsai et al. into the leveling process of Zuber et al as modified by Yano because Tsai et al. teach that usually, constant temperature and humidity are important to obtain an even coat (Col 19 lines 40-50).

With respect to the coating step occurring in a coating compartment and the leveling step occurring in a leveling compartment, the coating and leveling steps of Zuber et al as modified by Yano and Tsai et al. takes place in the same compartment which anticipates the limitation of to the coating step occurring in a coating compartment and the leveling step occurring in a leveling compartment as evidenced by the Examiner's interpretation of claim 21 wherein the Applicant claims that "the coating step (a) and the leveling step (b) are performed in one large compartment comprising a coating section and a leveling section."

With respect to the length of time of the leveling step, the disclosure Zuber et al as modified by Yano and Tsai et al. differs from Applicant's claims in that Zuber et al as modified by Yano and Tsai et al. do not disclose leveling times as claimed by Applicant. However, Yano recognize the need for adjusting the residence time of the polymer membrane in the drying station. Yano teach that if the mesh is not sufficiently leveled,

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pinholes are likely to be formed on the surface after drying and curing, so that the film tends to have a nonuniform thickness (Col 6 lines 25-45). Therefore, it would have been within the skill of the ordinary artisan to adjust the leveling time of the polymer membrane of Zuber et al as modified by Yano and Tsai et al. to within the Applicants claimed leveling time range in order to guarantee uniform thickness. *Discovery of optimum value of result effective variable in known process is ordinarily within skill of art.* In re Boesch, CCPA 1980, 617 F.2d 272, 205 USPQ215.

Zuber et al as modified by Yano and Tsai et al. do not specifically teach a surfactant amount in the range of 0.1%wt to 20% wt. However, Yoshino et al. disclose a printing process wherein In each of the case where the crosslinking agent is added to the dispersion of the alumina hydrate and the case where the crosslinking agent is impregnated into the ink-receiving layer, the amount to be added is preferably within a range of from 0.01 to 20% by weight, more preferably from 0.05 to 10% by weight based on the total weight of "the alumina hydrate and the binder". So far as the amount falls within this range, the occurrence of beading and feathering can be prevented even when printing is conducted on the resulting printing medium with inks containing a great amount of a surfactant (Paragraph 0126). Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the surfactant amount of Yoshino et al. in the process of Zuber et al as modified by Yano and Tsai et al. because Yoshino et al. teach that surfactant amount in this range prevents the occurrence of beading and feathering.

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Zuber et al, Yano et al. and Tsai et al as modified by Yoshino et al. are analogous art because they are from the similar problem solving area of printing a solids and surfactant based solution onto a substrate.

With respect to claim 2, Zuber et al also teach that based on protocol II of U.S. Pat. No. 5,234,777 an MEA was produced as follows: a dispersion of 1 g support catalyst (Degussa, 20% Pt on Vulcan XC72), 10 g of a 5% NAFION.RTM. Solution in low-boiling alcohols (Aldrich, Karlsruhe), 3.3 g glycerol (organic solvent), 8.2 g water and 0.47 g 1 N NaOH solution was prepared. (Col 8 lines 1-15).

With respect to claim 4, Zuber et al. teach that as shown by FIGS. 1 to 3, the catalyst layers according to the invention may be used to produce various components of fuel cell systems which can be marketed separately. FIG. 2, for example, shows a gas diffusion electrode, which is obtained when a gas diffusion structure is used as substrate material for the catalyst layer. This may be carbon fiber paper or nonwoven carbon fabric, for example (Col 7 lines 15-25).

With respect to claim 6, Zuber et al as modified by Yano does not specifically teach controlling the temperature and humidity. However, Tsai et al. disclose a method of making an energy storage device (title) wherein the coating solution is applied to the

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support by a spray method, cured, and optionally repeated to increase the thickness. A preferred procedure is to apply the coating solution to the substrate at a temperature of 0-150 °C by means of an ultrasonic or other spray nozzle with a flow rate of around 0.1-5 ml/min in a carrier gas composed of nitrogen, oxygen and/or other reactive and inert gases. The coating characteristics are controlled by the partial pressure of oxygen and other reactive gasses (Col 13 lines 40-50). Usually, constant temperature and humidity are important to obtain an even coat (Col 19 lines 40-50). Therefore it would have been obvious to one of ordinary skill in the art to incorporate the controlling of the temperature and humidity of Tsai et al. into the leveling process of Zuber et al as modified by Yano because Tsai et al. teach that usually, constant temperature and humidity are important to obtain an even coat (Col 19 lines 40-50).

Furthermore, it would have been within the skill of the ordinary artisan to adjust the temperature and humidity of the production process of Zuber et al as modified by Yano and Tsai et al. to within the Applicants claimed temperature and humidity range in order to obtain an even coat.. *Discovery of optimum value of result effective variable in known process is ordinarily within skill of art. In re Boesch*, CCPA 1980, 617 F.2d 272, 205 USPQ215.

With respect to claim 8, the disclosure Zuber et al differs from Applicant's claims in that Zuber et al. do not disclose drying times as claimed by Applicant. Zuber et al

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teach that thermal damage to the ionomer can consist in degradation of the proton-conducting functional groups, such as e.g. --SO₃H. In addition, irreversible changes to the structure of the polymer are possible which have a disadvantageous effect on the mechanical properties or the proton conductivity of the polymer. For tetrafluoroethylene-fluorovinyl ether copolymers with acid functions, e.g. NAFION[®] by Du Pont de Nemours, the suitable drying temperatures are between 60 and 200 °C., preferably between 70 and 160. °C (Col 6 lines 60-67).

With respect to the length of time of the drying step, the disclosure Zuber et al as modified by Yano and Tsai et al. differs from Applicant's claims in that Zuber et al as modified by Yano and Tsai et al. do not disclose drying times as claimed by Applicant. However, Yano recognize the need for adjusting the residence time of the polymer membrane in the drying station. Yano teach that if the mesh is not sufficiently leveled, pinholes are likely to be formed on the surface after drying and curing, so that the film tends to have a nonuniform thickness (Col 6 lines 25-45). Therefore, it would have been within the skill of the ordinary artisan to adjust the leveling time of the polymer membrane of Zuber et al as modified by Yano and Tsai et al. to within the Applicants claimed leveling time range in order to guarantee uniform thickness. *Discovery of optimum value of result effective variable in known process is ordinarily within skill of art. In re Boesch*, CCPA 1980, 617 F.2d 272, 205 USPQ215.

With respect to claims 22 and 23, the disclosure Zuber et al as differs from Applicant's claims in that Zuber et al do not specifically teach 5 to 20% wt of ionomer as

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claimed by Applicant. However, Zuber et al. recognize the need for adjusting the amount of ionomer in the ink. Zuber et al. teach that the weight ratio of the conductive carbon particles to the ionomer in the ink is typically between 5:1 and 1:1, preferably between 4:1 and 2:1. The desired precious metal load (area concentration in mg/cm.sup.2) of the finished catalyst layer can be adjusted by means of a corresponding weight ratio of the precious metals to the carbon particles in the ink, with a given layer thickness. Weight ratios of the precious metals to the carbon particles of between 1:10 and 4:1 are preferably used (Col 6 lines 25-35).

Therefore, it would have been within the skill of the ordinary artisan to adjust the amount of ionomer in the ink of Zuber et al to be within the Applicants claimed electrocatalyst range in order achieve the desired catalyst load. *Discovery of optimum value of result effective variable in known process is ordinarily within skill of art. In re Boesch*, CCPA 1980, 617 F.2d 272, 205 USPQ215.

Response to Arguments

4. Applicant's arguments filed on May 19th, 2009 have been fully considered but they are not persuasive.

Applicant's principal arguments are

(a). Zuber does not disclose water-based inks. The catalyst inks of Zuber comprise water in the form of an aqueous 15% NaOH solution. Thus, the ink in Table 1 of Zuber contains 0.98% water and the ink in Table 2 contains 1.56% water. As water is a very minor component of the Zuber inks, they cannot be considered "water-based".

Likewise, the Zuber inks do not meet the criteria set forth in the present application. On page 7, lines 4-7, of the specification, water-based catalyst ink compositions are described as comprising "an electrocatalyst, an ionomer resin, water (as a main solvent) and a surfactant ..." (emphasis added). The catalyst inks of Zuber do not have water as their main solvent.

Additionally, preferred water-based catalyst inks are defined in the present specification as containing "5 to 75 wt.% electrocatalyst, 10 to 75 wt.% of ionomer solution (water based or organic solvent based), 10 to 75 wt.% of deionized water, 0 to 50 wt.% of organic solvents and 0.1 to 20 wt.% of surfactant with a vapor pressure of 1 to 600 Pa" (page 7, lines 28-31, emphasis added). The inks of Zuber do not have 10 to 75 wt.% of deionized water.

(b) The amount of catalyst present in the ink composition of the example does not meet the new limitation set forth in amended claim 1. In the example, the catalyst has a concentration of 4.3 wt.% (1g catalyst / 22.97g for the total weight of the ink composition)

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-- thus, outside the range of 5 to 75 wt.% of electrocatalyst required by the present claims.

(c) The Zuber reference is furthermore silent with respect to:

- the leveling step;
- the surfactant having a certain vapor pressure; and
- the surfactant having a certain weight range.

In response to Applicant's arguments, please consider the following comments.

(a) Zuber et al also teach that based on protocol II of U.S. Pat. No. 5,234,777 an MEA was produced as follows: a dispersion of 1 g support catalyst (Degussa, 20% Pt on Vulcan XC72), 10 g of a 5% NAFION.RTM. Solution in low-boiling alcohols (Aldrich, Karlsruhe), 3.3 g glycerol, 8.2 g water and 0.47 g 1 N NaOH solution was prepared. The mixture was dispersed in an ultrasound bath (Examiner notes that in this composition water is present at approximatey 35% water).

(b) With respect to the amount of catalyst in the ink solution the disclosure Zuber et al as differs from Applicant's claims in that Zuber et al do not 5%-75%wt. of

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electrocatalyst claimed by Applicant. However, Zuber et al. recognize the need for adjusting the amount of catalyst in the ink. Zuber et al. teach that the weight ratio of the conductive carbon particles to the ionomer in the ink is typically between 5:1 and 1:1, preferably between 4:1 and 2:1. The desired precious metal load (area concentration in mg/cm²) of the finished catalyst layer can be adjusted by means of a corresponding weight ratio of the precious metals to the carbon particles in the ink, with a given layer thickness. Weight ratios of the precious metals to the carbon particles of between 1:10 and 4:1 are preferably used (Col 6 lines 25-35).

Therefore, it would have been within the skill of the ordinary artisan to adjust the amount of electrocatalyst in the ink of Zuber et al to be within the Applicants claimed electrocatalyst range in order achieve the desired catalyst load. *Discovery of optimum value of result effective variable in known process is ordinarily within skill of art. In re Boesch*, CCPA 1980, 617 F.2d 272, 205 USPQ215.

(c) Zuber et al as modified by Yano and Tsai et al. do not specifically teach a surfactant amount in the range of 0.1%wt to 20% wt. However, Yoshino et al. disclose a printing process wherein In each of the case where the crosslinking agent is added to the dispersion of the alumina hydrate and the case where the crosslinking agent is impregnated into the ink-receiving layer, the amount to be added is preferably within a range of from 0.01 to 20% by weight, more preferably from 0.05 to 10% by weight based on the total weight of "the alumina hydrate and the binder". So far as the amount falls within this range, the occurrence of beading and feathering can be prevented even

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when printing is conducted on the resulting printing medium with inks containing a great amount of a surfactant (Paragraph 0126). Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the surfactant amount of Yoshino et al. in the process of Zuber et al as modified by Yano and Tsai et al. because Yoshino et al. teach that surfactant amount in this range prevents the occurrence of beading and feathering.

Zuber et al, Yano et al. and Tsai et al as modified by Yoshino et al. are analogous art because they are from the similar problem solving area of printing a solids and surfactant based solution onto a substrate.

Zuber et al. does not specifically teach leveling the deposited catalyst ink. However, Yano disclose an ink composition (title) wherein when the amount of the leveling agent is less than about 0.1 part by weight, a rough surface of the coating film attributed to the remainder of the foam generated at the time of the printing and the screen mesh is not sufficiently leveled, and pinholes are likely to be formed on the surface after drying and curing, so that the film tends to have a nonuniform thickness (Col 6 lines 25-45). Therefore it would have been obvious to incorporate the leveling procedure of Yano into the process of Zuber et al. because Yano teach that if the mesh is not sufficiently leveled, pinholes are likely to be formed on the surface after drying and curing, so that the film tends to have a nonuniform thickness (Col 6 lines 25-45).

Zuber et al as modified by Yano does not specifically teach controlling the temperature and humidity. However, Tsai et al. disclose a method of making an energy storage device (title) wherein the coating solution is applied to the support by a spray

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method, cured, and optionally repeated to increase the thickness. A preferred procedure is to apply the coating solution to the substrate at a temperature of 0-150 °C by means of an ultrasonic or other spray nozzle with a flow rate of around 0.1-5 ml/min in a carrier gas composed of nitrogen, oxygen and/or other reactive and inert gases. The coating characteristics are controlled by the partial pressure of oxygen and other reactive gasses (Col 13 lines 40-50). Usually, constant temperature and humidity are important to obtain an even coat (Col 19 lines 40-50). Therefore it would have been obvious to one of ordinary skill in the art to incorporate the controlling of the temperature and humidity of Tsai et al. into the leveling process of Zuber et al as modified by Yano because Tsai et al. teach that usually, constant temperature and humidity are important to obtain an even coat (Col 19 lines 40-50).

Conclusion

5. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not

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mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ben Lewis whose telephone number is 571-272-6481. The examiner can normally be reached on 8:30am - 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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/Ben Lewis/

Examiner, Art Unit 1795

/PATRICK RYAN/

Supervisory Patent Examiner, Art Unit 1795